

# **Chapter . I**

Introduction

## CHAPTER - I

1.1 INTRODUCTION : The socio-economic condition of any nation is pivoted on the mineral resources available for utilisation for the development of mineral based industries.

The mineral deposits are of primary and secondary in their origin. The mineral deposits having primary origin are those of magmatic, metamorphic and hydrothermal, which have formed at relatively deeper levels of the earth at high temperature and pressure; while the mineral deposits of secondary origin include residual, supergene enrichment and placers, which have formed at the surface of the earth at relatively low temperature and pressure due to interaction of hydrosphere, biosphere and atmosphere.

Of the mineral deposits having secondary origin, the placers are found widespread along the coastline. These placers, which are easily and profitably mineable, deserve attention due to their high metal and/or mineral concentration.

The term placer means 'Sand Bank' a spanish word which was freely used by the early settlers in USA. The placer is a deposit of sand or gravel that contains the detritals of valuable minerals in sufficient quantity. The placer deposits of importance are of metals and minerals like gold, platinum, monazite, diamond, corundum, garnet, zircon, sillimanite, casseterite, ilmenite, rutile, magnetite etc.

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Placers are formed due to the physical disintegration followed by chemical decomposition of the parent rocks. These two processes involve the formation of secondary minerals and the release of resistant primary minerals, which find their way into the sea through rivers and streams. The resistant nature of minerals which get released due to the surface geological processes are dictated by their properties such as size, shape, hardness, specific gravity and chemical stability. The process of mechanical enrichment is due to the gamut of variables such as natural gravity separation of heavy minerals from light minerals and the lies. Later their concentration depends upon the forces operating along the coast fronting the open sea such as winds, waves, tides and ocean currents.

1.2 TYPES OF PLACER DEPOSITS : Various types of classifications of placer deposits have been proposed by different investigators like Emery and Noake, (1968); Well, (1969); Toom, (1970); Smirnov, (1976); Macdonald, (1983) and Batman, (1987). In most of their classifications, the process variables, and the environment of formation have been given due emphasis.

Emery and Noake, (1968) considered specific gravity and environment of deposition as the basis for grouping the placer deposits into two broad classes as, 1. Heavy-heavy placer minerals (specific gravity > 14) 2. Light-heavy placer minerals (specific gravity < 6).

Tooms, (1970) has made the exhaustive study of the

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marine placer deposits and has grouped them in four major groups as, 1. Submerged alluvial placers 2. Alluvial placers 3. Drowned beach and dune placers and 4. Marine placers.

Later Macdonald, (1983) proposed a classification based on the sedimentary environments in three major classes. 1. Continental 2. Transitional and 3. Marine and beach environment.

The subclasses in the continental environment are alluvial, colluvial and fluvial, whose products may result in the placer deposits of gold and platinum. Transitional environment has only one subclass as strand-line resulting in the deposition of zircon, diamond, and other precious minerals. In the third class, the minerals of placers such as rutile, ilmenite and zircon are subclassed as drowned placers.

Batman, (1987) has attempted the classification of placers on the basis of combination of mode of transport and the sedimentary environment of formation. It is as 1. Eluvial - formed on the sites of destruction of the primary rock ; 2. Deluvial - when the weathered and disintegrated material is shifted down-hill ; 3. Colluvial - when the material is accumulated at the foot of a hill slope ; 4. Alluvial - when the weathered material is carried away by streams and rivers, 5. Beach placers - when they are built along the shore; 6. Eoline - when they are formed due to wind action.

1.3 PLACER DEPOSITS OF INDIA :The placer deposits in India occur all along the coast of peninsular India and few inland tracks. Prabhakar Rao, (1974) has catagorised the placer deposits of India based on the sedimentary environments into two groups as 1.Coastal deposits including dunes and 2.Inland deposits including alluvial and older alluvial deposits.

The placer deposits which are formed along the coast of peninsular India are due to the combination of fluvial and marine environments. Most of the Indian placer deposits can be divided into four major divisions as 1. Beach and dune sand placers occuring along the east and west coast. 2. The inland placer deposits as found in the south Tamil-Nadu. 3. The older alluvial deposits as found in the states of Bihar and West Bengal and lastly, 4.The fluvial and alluvial deposits in the state of Madhya Pradesh.

Amongst the above mentioned placer deposits, the deposits of the marine and transitional environment along the east and west coast tracks of the peninsular India are rich in heavy minerals. In the Ratnagiri Coast which forms the part of west coast of Maharashtra, the placer deposits occur as isolated and richly concentrated with the minerals like ilmenite and magnetite, which are of economic significance. Within the Ratnagiri Coast which extends to a length of about 40 km.,the localities like Bhatya, Kalbadevi and Newara contain economically significant amount of

ilmenite with magnetite and other iron-oxides as the heavy mineral suite. The present area of investigation is confined to the Newara beach.

**1.4 AREA OF INVESTIGATION :** The Newara area represents a part of western coast of Ratnagiri district of Maharashtra State. It is one of the beaches along the west coast of India. In the present investigation the area covered for the study of beach placers and part of its hinterland is approximately 20 sq.km. This area forms the part of the Survey of India topographic sheet No.47 G/8 of 1:50,000 scale; at Lat.  $17^{\circ}07'$  N and Long.  $72^{\circ}17'$  E (Map 1.1). It lies to the north of Ratnagiri city and south of Ganapatipule, a important tourist place. Newara village lies west of Bombay-Goa highway between Ratnagiri and Sangmeshwar. The village can be reached by state transport bus service. However, the beach is 6 km from the village which can be accessible by a fair weather cart tract (Map 1.1).

**1.5 CLIMATE, DRAINAGE AND VEGETATION ;** The evolution of any placer deposit cannot be treated in isolation without due emphasis to the hinterland geology, physiography, climate, drainage and vegetation of the region. All these factors are important in the physical disintegration and chemical decomposition of the rocks from which the heavy minerals are derived.

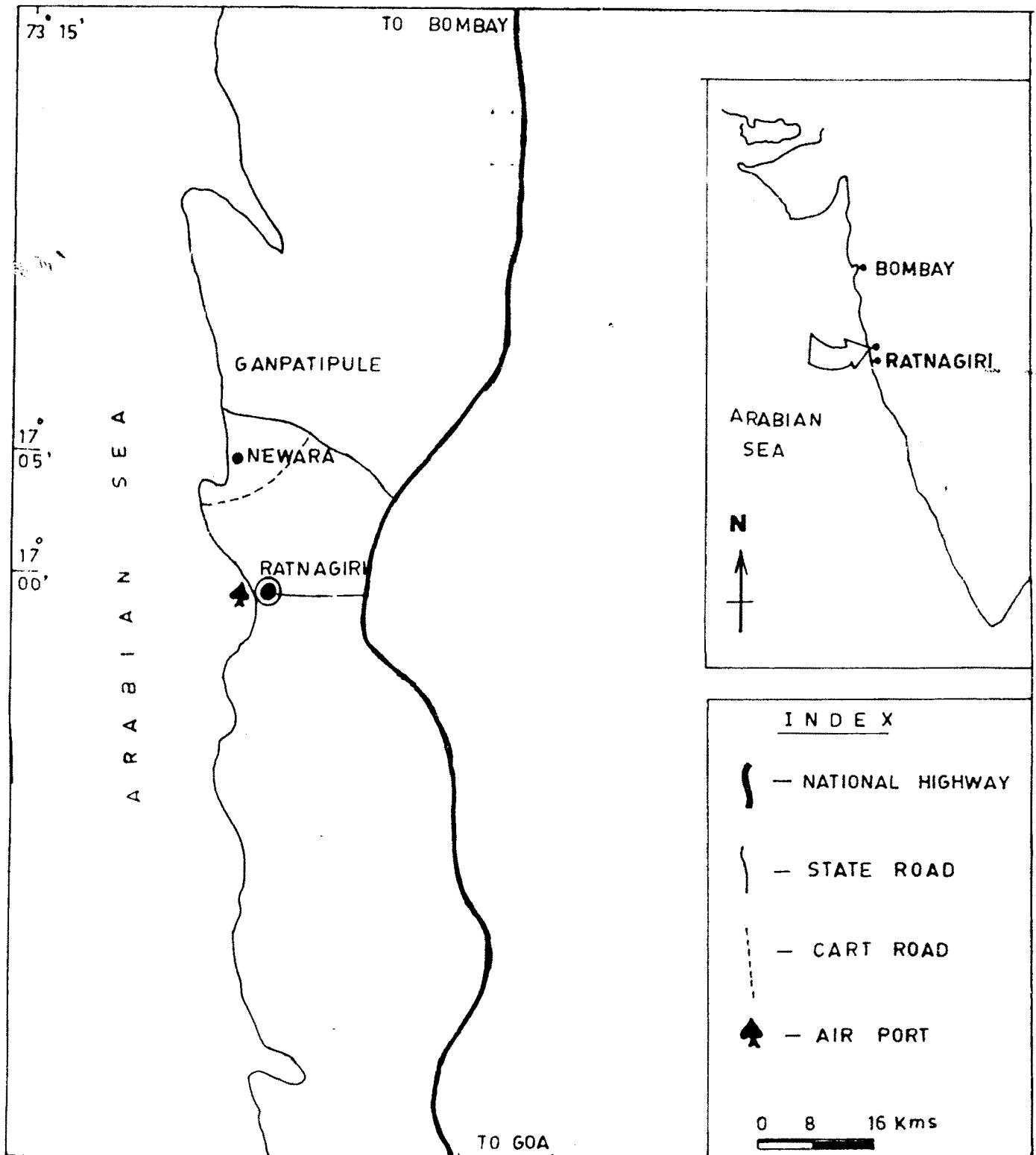


FIG. 1.1 ACCESSIBILITY MAP

The present area of investigation lies under tropical humid climate and receives about 300 cms. aggregate annual rainfall mainly precipitated during the south-west monsoon. The temperature varies between 20°c to 40°c and has high relative humidity.

The drainage of this area has the imprints of the surface geological structures such as joint pattern and fracture system, which results mainly in sub-dendritic and to a sub-ordinate extent sub-parallel drainage pattern on the laterites.

The climatic conditions such as heavy rainfall, high temperature and high relative humidity are suitable for the mango and cashew plantation which is extensively carried out.

1.6 PREVIOUS WORK ; Considering the involvement of sedimentary processes in placer formation, the works of noteworthy contributors in sedimentology was consulted, which has been briefly dealt with in the following paragraphs.

Krumbein (1939) suggested use of graphic presentation of statistical analysis in sedimentology. Three modes of sediment transport - traction, saltation and suspension were recognised by Inman (1949). Shephard and Moore (1954) described the grain size frequency distribution of modern sediments in detail. Friedman (1961) have given the use of textural characteristics for distinction between



the dune, beach and river sands. Later in 1967, he compared dynamic processes and statistical parameters, for size frequency distribution of beach and river sands. Visher's work in 1969 on grain-size distribution and deposition process of both modern and ancient sand has provided the basis for a genetic interpretation of sand texture.

The Indian Coast in general and the west coast in particularly those of Kerala, Maharashtra and Goa were extensively investigated by many researchers. Veerayya (1972) described the wave characters and grain-size morphology of Goa beaches. Hashimi et.al (1978) determined the grain-size of coarser fraction of sediments between Vengurla and Manglore. The studies of the wave refraction in relation to sediment transport tendency along the west coast of India have been carried out by Reddy (1976). Textural parameters of Bombay and Dwarka coast have been studied by Choudhari, et.al (1981). Sukhtankar (1986) studied on trends in grain-size measures of the Quaternary sediments of the Vengurla coast, Maharashtra with reference to beach morphology and tectonic evolution. Nayak and Chavadi (1987) worked on seasonal variations of Polem beach, where in the variation from the general trend of grain-size parameters have been interpreted. Textural and minerological studies of the beach sands from Fort Cochin to Chellanam, Kerala have been carried out by Purandara et.al (1987).

Some workers attempted to use grain-size to determine the sedimentary environments. Folk and Ward (1957) used the texture for environmental identification. Reineck and Singh (1980) in their book entitled "Depositional Sedimentary Environments" described several aspects of sediment transport, near shore currents and wave ripples on beaches.

Some workers studied in detail about coastal geomorphology and beach processes. Davis (1972) described world coastal morphology and factors of geographical variation. Komar (1976) in his work on "Beach Processes and Sedimentation" described the configuration and classification, theory of wave motion, sediment movement and morphology of the beaches. Ahmed (1972) is the first to attempt the concise account of geomorphology of Indian Coasts on the basis of data from large scale topographic maps.

The richness of the placer deposits and their peculiar features made many research workers to work on and reveal intrinsic informations. The early work was confined in identification and extension of placer deposits. The organisations like Atomic Mineral Division, Geological Survey of India, Indian Bureau of Mines, Department of Geology and Mines of Maharashtra and National Institute of Oceanography have worked the placer deposits with an aim to find out the extension and reserves. However, the detail

work on mineralogy, provenance, typical occurrence, environment and possible factors of their formation, economic potential and implications of neotectonic activities on heavy mineral concentration are singularly lacking.

The heavy mineral rich black sand have been studied in other countries by different workers. Cogen (1940) worked out heavy mineral zones of Louisiana and Texas Gulf Coast Sediments. Ilmenite deposits at Piney River Virginia have been studied in detail by Davidson et.al (1946). Bailey et.al (1956) studied ilmenite rich beach sand from Mozambique, Ceylon, Florida and Brazil and found out different alteration stages. Heavy mineral variation in San Antonia and Mezquite bays of the central Texas Coast have been determined by Poole (1958). The studies on distribution and properties of placer ilmenite in East Rosetta Beach sands of Egypt, with ore microscopic studies, has been given by Wassef (1981). Pirkle, et.al (1989) gave their observations during the study of Altama heavy mineral deposits in south eastern Georgia. Recently, Mitra and Syed (1990) carried out investigation of the Beach and Dune sands of Cox's Bazar, Bangladesh and detailed the distribution of the heavy minerals depending upon the textural characteristics like size, and shape. They have also differencited relative abundance of opaques and non opaques in dune and beach environments.

While the work on these aspects in India wasy



insignificant in early 20th century. Tipper (1914) was the first to study the monazite sands of Travancore in detail. Ilmenite rich sands along Ratnagiri Coast has been worked out by Roy (1958). Placer deposits of Ranchi Purulia plateau have been studied by Shirke and Chatterji (1958).

In India the detailed work came only during the last few decades from the pioneering contribution of different investigators. Poulse (1972) studied black sand deposits along Kerala Coast and recognised different stages of geological processes of development. Prabhakar Rao (1974) carried out studies on Indian placers and has given their evolution and their types. Mallik (1974) studied heavy mineral placers in the beaches and off shore areas with emphasis on their nature, origin and economic potential. Heavy minerals in the sediments on the outer continental shelf between Vengurla and Manglore on the West Coast of India have been studied by Kidwai et.al (1981). Mallick et.al (1987) discussed the distribution and mineralogy of the black sands of the beaches of Kerala and identified their provenance. Dhanaraju and Krishnaih Snetty (1988) used magnetite content as a basis to recognise potential heavy mineral zones along Nizampatanam Coast of Andhra Pradesh. Ilmenite, zircon and rutile bearing placer deposits of Gopalpur beach of Orissa have been studied by Patro et.al (1989). Acharya et.al (1989) have worked out characteristic behaviour and occurrence of cassiterite bearing placer

deposits from Koraput district, Orissa.

Beach placer deposits of Ratnagiri district, Maharashtra have been studied by different workers from different organisations. Sengupta and Rao (1976) carried out investigation along beaches and inland areas of Ratnagiri Coast of Maharashtra with an aim to know and decipher the source of the heavy minerals. Department of Geology and Mines, Maharashtra State surveyed the ilmenite placers on the beaches of Ratnagiri and calculated the total reserves to the tune of 4 million tons. Siddiquie and Rajmanikam (1979) gave detailed account of surficial heavy mineral deposits of continental shelf of India and discussed about their source. Siddiquie et.al (1979) used seismic method to delineate richer zones of heavy minerals and from their detailed work in laboratory, they brought out map of heavy mineral distribution along the Ratnagiri Coast and its offshore. Joshi and Patil (1990) worked out beach sand deposits of Newara and indicated the significance of mechanical analysis in heavy mineral separation.

**1.7 OBJECTIVES :** : The present study on placer deposits of Newara is mainly intended to i. delineate richer zone of heavy mineral concentration ii. know the mineralogy of the heavy minerals bearing sands iii. find out environment of heavy mineral deposition and iv. decipher the source and factors responsible for heavy mineral enrichment.